An Engineering/Cadastral Database for Purdue University

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Let me begin by relating some background on how we got started on this engineering/cadastral database at Purdue. I really must give credit to professor Warren Marks, from whom I took classes when I was in school at Purdue. Professor Marks is at Penn State University now, but a few years ago he tried to get Tippecanoe County interested and involved in what was basically a geographic information system. It wasn't called that at the time. That buzz word is more recent.

Warren was ahead of his time, though, because everyone was worried about where the money was going to come from. We don't worry about that today, as I understand it. Plus, private industry and government didn't want to work together. Of course, that doesn't happen today either. Professor Marks' work turned on a light bulb with me, because one of my jobs as a student in facilities planning was to update thirty to forty maps every time there was a change made on campus. These maps, which we still use today to a certain extent show utilities and other information we have on one to one hundred scale pieces of linen.

That was very frustrating because the accuracy was terrible. At times, a pencil width was a couple of hundred feet. Plus, the maps didn't match. You couldn't compare one against another because they were drawn from 1934 to 1942 aerial photography. Now, I'm sure that no one has seen those kind of maps in their office. Everyone has an up-to-date map they use today, right?

Recently, we had an opportunity to re-fly our campus. It had been about ten years since we had taken any aerial photographs. We try to refly the various campuses on a five-year reoccurring basis. Once you snap that photograph, it's out of date, and we are not a static university. We are a dynamic university. We will almost double the number of facilities at our Fort Wayne campus in the next year. We're adding a 700 car parking garage, a new fine arts facility, a theater complex, a technology facility and a science building. All of that is merely at a regional campus.

So, once this opportunity to refly the campus arose, my boss and I sat down to figure the budget. We added ten percent per year to the cost of the aerial photographs taken ten years before, and came up with a budget. What happened though, was the cost of aerial photography had gone down. The cameras were better. The film quality was better. So, the actual cost to prepare a map from aerial photography had gone down in ten years.

Since We ended up with some money left over, we were able to have the main core of the campus mapped on a one to fifty inch scale. Everything that was photo-identifiable was shown and put into an electronic database. To save a few

extra dollars, and get this engineering/cadastral database on the road, we did our own control work. That is how we got started.

Is what we're doing at Purdue University — from an engineering standpoint — different from a Geographic Information System (GIS) or LIS? Well, a few years ago, the difference between GIS/LIS and AM/FM (Automated Mapping/Facilities Management) engineering databases, was fairly broad. The Geographic Information Systems were based upon 7.5 minute quadrangle maps. So, the accuracy on these was not very good from an engineering standpoint. The long-range planners liked the because they could put a great deal of information into the database. The problem was, that database was useless to me as an engineer. For planners, and facilities maintenance people, it was quite adequate, because they had, in the database, information that they never had readily available to them before. As the technology has increased, that definition between AM-FM and GIS has really narrowed. We now have the capability with better surveying instruments and knowledge to get higher accuracy at the same low cost of the digitation that was done in the 7.5 minute quadrangle maps. The main difference today between them today is the scale in which each is referred to and the foundation on which each is based.

Of course there is a cost to accuracy, and that cost goes up exponentially. The more accurate you want to make the system, the more it will cost. Although, that extra cost is only in the initial work, the foundation used upon which the system is built. That is where the greatest cost occurs. when you look at the overall cost of implementing an entire system, whether it's for tax mapping, engineering design, fire and police protection, parts identification or facilities management, the cost of the application is a very small part of the total cost of the project.

When creating an engineering database, always look at it in terms of upward mobility, or versatility. The only way to get that upward mobility is to build a strong foundation. You don't build a skyscraper on a foundation that's eighteen inches wide and twelve inches thick. An engineering database is created in the same manner in which the skyscraper is built. You don't put the roof on first, you build the foundation. The infrastructure foundations of a GIS are the public land survey corners, the geodetic corners that might be in a community and any other surveying information of sound accuracy. These tied together form a strong foundation upon which can be built any GIS, AM/FM or LIS.

What is a GIS? It's a special relationship. It's three dimensional, and it has a lot of information contained in it. Much of the information that goes in doesn't depend upon the accuracy of the positioning of the points. The benefit of a GIS is that we can get information out of it that will help us manage our organization or systems and decide whether to increase or decrease our budget. Why do we do it? Duplication of effort is very costly. I hate to change three maps let alone thirty maps every time we made a major change. Sometimes we changed all those maps even if we made a minor change.

Most managers realize the myriad of information they have to have when they get into a project — how many sources they have to search to acquire the information they need to have to make a proper decision. It's scary. Many times you miss something because of time. Somebody wants an instant decision, or there is a sewer or water main broken, and you need to know where the valves are to shut it off.

Purdue University is a city within a city. As we continue to grow, our utilitie. continue to stack up one on top of another. We have this parking lot at the nev mall. If I had x-ray vision, I would see a spaghetti bowl of utility lines underneatl there. There are sewers and water mains and tunnels and conduits and drainage systems and irrigation systems all within this confined area. If one of them breaks or fails, I need to know where the rest of them are so we don't destroy a lot of material to get to the problem. In Tippecanoe County alone last year, more than $1 million was spent in infrastructure repair by public and private utilities. That's because we don't know where things are. That's one of the reasons we created this database.

Maintenance and upkeep of any kind of a database has always been extremely labor-intensive, and I guarantee you it's no different with the computer. The difference is that you have something that is readily accessible. Technology has allowed us to be able to create these new databases, and we, as professionals, must leave those who follow a better defense and grouping of information than we had to work with. Whenever I get into a new project, one of my frustrations when I stamp a set of plans is not knowing how many things I may have missed. I guarantee that the back-hoe will find them. Then they come back to me and say, "Pusey, why didn't you know they were there? They were only put in back in 1910."

Obviously, the more accurate the we can make the database, the better it is. You can put into an engineering database less accurate information, and you will not necessarily hurt it if you categorize the weight or the value of the information that was put in. Many databases do not give a prioritization of where the information is from. We use a sliding scale. The highest value of information comes from a field crew that physically goes out and ties off x, y, and z of a known utility or entity. The lowest comes out of the head of the plumber who has worked in the plumbing shop for over twenty years.

You have to put all of the information in the database, though, because the information from the plumber may be the only information available to you on a given subject. From a design and reference standpoint, though, you need to know which information is more reliable. Otherwise, you we get yourself into danger. I've seen this happen.

I know of one person who was bidding on a project for General Motors to recreate their database. General Motors had taken all of their maps and information, digitized them and put them into a computer. Unfortunately, no one had taken the time to inspect the data. No one said, "This is good, this is bad, this is not bad." In a three week period, on three major construction projects, GM knocked out the power to the whole acreage, cut through a fourteen inch gas main that was right underneath the footing of a new office building, and cut through the main water feed to the facility. Needless to say, they now wanted to classify their engineering information.

Who uses an engineering database like GIS? Managers use it. Politicians use it. The value from tax mapping, in some instances, can pay for a good engineering database, because you'll find that you have facilities that haven't been taxed in years or are not properly noted. It is applicable every where we go. It's applicable in all of our jobs.

The hardest jobs of all though, are in the setting up and maintaining of the database. I've got seven jobs listed below that need to be addressed. One, you

need to teach management that the process is needed and will pay for itself. The managers control the money. Some managers we deal with today, and some engineers as well, say "I'm old enough, I don't want to have to learn this, but I won't keep you from learning it." Unfortunately, there a few bosses that don't necessarily feel that way, so we have to surmount that. Two, you must realize that the maintenance and upkeep of the system will take as much time as the initial setup of the system. Any system of information is only as good as the most current piece of information that is utilized by the system. The third job is finding a way to pay for the system. Then, once you have the database set up, you need to finance the maintenance to take care of the beast.

The next two jobs are, perhaps, the most important, and have to be addressed early on, because if you don't the lawyers will get involved. Once you've gathered and digitized this information, you need to decide who has the right to use that information, and for what purpose. I guarantee you, somebody might try to abuse it, or may abuse it. So, you may also have to answer the question, who has access to the information? Plus, where, when and how will they have access to it? Our local sheriff's department has a brand new jail, a fine new incarceration system, a 911 system and a tracking system for their cars. They would love to have a GIS to be able to track their cars and have partial identifiers so their computer could direct the officers to the quickest route to a given scene of a crime, accident, etc. They obviously have to control this system. They wanted to be the only ones accessible to it. Well, maybe to the accident information, the number of rapes in a given area, robberies, etc. The base map, though, has to be controlled by some entity that can maintain it and the other non-compromising information.

The next job is one I highlighted earlier. You need to establish a firm foundation on which to build. You can add less accurate information to an accurate database. But you can't make an inaccurate database accurate with more stringent information. Establishing a scale for relative accuracy of the information entered is a tool that will save many, many dollars in the future. The last job is one I enjoy because I deal with a lot of contractors. You need to re-educate everyone that an as-built piece of information is not the chicken scratchings on a set of plans that a contractor submits to get his last 10 percent of payment.